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(71) Applicant : **XEROX CORPORATION**
Xerox Square
Rochester New York 14644 (US)

(72) Inventor : **Carlotta, Michael**
7048 Old Ridge Road
Sodus, New York 14551 (US)

(74) Representative : **Johnson, Reginald George et al**
Rank Xerox Patent Department, Albion House,
55-59 New Oxford Street
London WC1A 1BS (GB)

(54) A seal for a printhead face.

(57) A removable seal (28) for the face of a printhead (10) is a laminate tab made of a flexible, tear resistant material (30) having a layer of low temperature melt material (32) on one side thereof. The seal (28) is molded to the face of the printhead (10) by applying heat to the laminate tab to reflow the low temperature melt material (32) onto the face of the printhead. The seal (28) extends beyond at least one side of the face of the printhead to form an easily graspable, removable tab. The seal is used during shipping and handling to prevent ink from leaking from the printhead and to prevent contamination and damage of the nozzles.

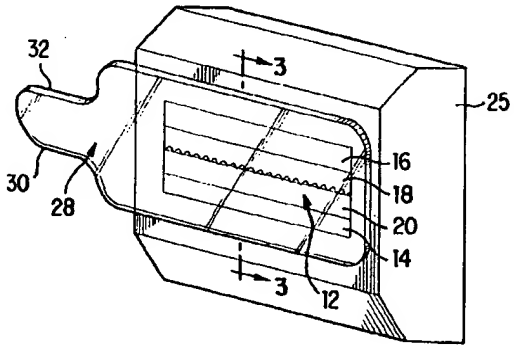

FIG. 2

EP 0 576 237 A2

The pres nt invention relates to a seal for a printhead and the process for producing the seal. More particularly, the invention relat s to a removabl seal molded to the face of a printhead for sealing the nozzles of the printhead during shipping and handling.

Thermal ink jet printing systems use thermal energy to produce a vapor bubble in an ink filled channel in a printhead that expels a droplet of ink onto a recording medium, such as paper. The thermal energy is selectively produced by resistors located in capillary-filled ink channels in the printhead near channel terminating nozzles or orifices in the face of the printhead to momentarily vaporize the ink and form bubbles on demand. Each temporary bubble expels an ink droplet and propels it towards a recording medium. The printing system may be incorporated in either a carriage-type printer or a pagewidth type printer. The carriage-type printer generally has a relatively small printhead containing the ink channels and nozzles. The printhead is usually sealingly attached to an ink manifold or to a cartridge assembly and is reciprocated to print one swath of information at a time on a stationarily held recording medium, such as paper. After the swath is printed, the paper is stepped a distance equal to the height of the printed swath, so that the next printed swath will be contiguous therewith. The procedure is repeated until the entire page is printed. In contrast, the pagewidth printer has a stationary printhead having a length equal to or greater than the width of the paper. The paper is continuously moved past the pagewidth printhead in a direction normal to the printhead length and at a constant speed during the printing process.

Ink jet printing systems often experience several problems which adversely affect the quality and performance of printing. Among these problems are 1) evaporation of the volatile ink ingredients, including water; 2) clogging of the printhead nozzles caused by ink drying therein due to non-use for a period of time; 3) adherence of dust to the nozzle-containing face of the printhead due to the moisture of fluid ink around the nozzle; 4) leakage of ink from the nozzles; and 5) bubbles and dust taken into the printhead nozzles.

Shipping and handling prior to installation of a printhead often cause or at least aggravate the above- mentioned problems. A printhead will be jostled and tilted during shipment and installation, often causing ink to leak from the nozzles into the packaging thus wasting ink and resulting in additional time and effort in cleaning the printhead. Further, the nozzles can become clogged with dry ink or debris, and the ink channels can dry up and clog between th time the printhead is packaged for shipping and ultimately installed in a printer.

Th refore, manufacturers of printheads have attempted s v ral techniques to seal the face of a printhead during shipping and handling. One such technique merely consists of applying tape or Mylar to the face of the printhead. How ver, these materials do not adhere well to the face of the printhead due to irregularities in th surface of the printhead die. Further, tape can leave adhesive residue on the face of the printhead which will later interfere with the printing operation. Another technique involves adhering tape onto the face of the printhead and then pressing a piece of plastic foam onto the tape. However, the foam cover requires additional space, cost and packaging. Also, the face of a thermal ink jet printhead may be uneven or irregular due to tolerances of the channel plate, heater plate, manifold and heat sink. The above materials do not easily accommodate such unevenness and therefore may leave gaps between the face of the printhead and the seal, resulting in leakage.

Thus, there is a need to provide an effective, yet easily removable, seal on the face of a printhead which is easy to manufacture and cost effective.

Accordingly, it is an object of the present invention to provide a seal on the face of the printhead which effectively prevents leakage of ink from within the printhead and prevents contamination of the nozzles from external sources.

Another object of the present invention is to provide a seal which accommodates an uneven surface of the face of the printhead.

A further object of the present invention is to provide a seal which is easily and quickly removed from the face of the printhead.

A further object of the present invention is to provide a seal which is easily and economically manufactured and applied to the face of the printhead.

The foregoing and other objects are attained by providing a seal for a printhead face comprising a laminate tab including a film having a layer of low-temperature melt material disposed on one side thereof for molding to the face of the printhead.

The foregoing objects are also attained by providing a printhead assembly comprising a printhead die with a face having nozzles therein and a seal removably secured to the face. The seal includes a laminate tab having a first layer and a second layer of low-temperature melt material coupled to the first layer, with the second layer being reflowed onto the face and covering the nozzles.

The foregoing objects are further obtained by a method of sealing the face of a printhead comprising thermally bonding a removable film laminate tab onto the face. The method of sealing the face of a printhead with a laminate tab includes using a tab with a l w-melt material on one side thereof and comprises forming a breakaway tab in a web of laminate film and applying th low melt material side of the tab to the face of the printhead including breaking th tab from the web and m lding th tab onto the face.

The present invention will be described further, by way of examples, with reference to the accompa-

nying drawings, in which:-

Figure 1 is a partial perspective view of a printhead for use with the present invention;

Figure 2 is a perspective view of a front face of the printhead of Figure 1 including a seal in accordance with an embodiment of the present invention;

Figure 3 is a partial side view in section of the seal of Figure 2 taken along line 3-3; and

Figure 4 is a schematic perspective view of a method for manufacturing the seal and applying the seal to the face of a printhead.

As seen in Figure 1, a printhead 10 includes a printhead die 12 coupled to a heat sink substrate 14. Figure 1 represents a thermal ink jet cartridge type printhead which would typically be connected to an ink manifold 16 via an aperture (not shown).

Printhead die 12 includes a channel plate 18 coupled to a heater plate 20. The surface of heater plate 20, to which channel plate 18 is attached, has a plurality of resistive heater elements (not shown). The opposite surface of heater plate 20 is bonded to substrate 14. The surface of channel plate 18, positioned on heater plate 20, has grooves therein which define ink channels 24 that end in nozzles 26 in the front face of printhead die 12. Channel plate 18 and heater plate 20 are coupled together and a dicing action is performed to achieve coplanarity along the front face to produce nozzles 26. Ink channels 24 communicate with the aperture of manifold 16 in order to allow ink to flow from an ink manifold through ink channels 24 to nozzles 26. A front face of the printhead is surrounded by a face plate 25 which extends around the printhead components.

As shown in Figure 2, a seal 28 is secured to the front face of printhead die 12. Seal 28 is a thin film laminate comprising a layer of flexible, tear resistant film 30 and a layer of low-temperature melt material 32. Seal 28 is sized to fully cover nozzles 26 and extend beyond the face of printhead die 12 on at least one edge, thus forming a pull tab for easy removal. Preferably, seal 28 extends beyond the printhead die 12 on all edges to partially cover face plate 25 (as shown). Low temperature melt material layer 32 is applied to the face of printhead die 12 and flexible, tear resistant film layer 30 forms the exterior side of seal 28.

Referring to Figure 3, flexible, tear resistant film layer 30 is preferably made of a plastic material, such as polyester. Layer 30 has a higher melting temperature than layer 32. Any conventional flexible, tear resistant material could also be used, including fabric or paper. Low temperature melt material lay r 32 is also preferably made of plastic but may consist of any easily meltable material. In the preferred mbodiment, layer 32 is mad of H.B. Fuller's HM1580 FF16 which becomes flowable upon application f heat but seals upon cooling. Any material which will reflow onto the face of the printhead to provide a s cure seal over nozzles 26 is suitable, even wax. Use of the flowable, low-temperature melt material 32 does not have an adhesive residue and thus overcomes any problem associated with an adhesive residue remaining on the face of the printhead as in the prior art.

The process for applying the tab essentially includes tacking the tab to the face of the printhead die in a position which covers the nozzles and preferably extends onto face plate 25 and then applying heat to the tab tacked onto the die to reflow the low-temperature melt material layer and thus mold the seal onto the printhead. It is not necessary to carefully align the tab on the face of the printhead since it is merely for sealing purposes and will be removed prior to use. Therefore, it is only necessary to ensure that the seal covers the nozzles.

A method of manufacturing the seal is shown schematically in Figure 4. In the process illustrated in Figure 4, a web 34 of laminate material carried on a spool 36 comprises an upper layer of flexible, tear resistant film 30 and a lower layer of low melt material 32. Beginning at the lefthand side of Figure 4, web 34 is drawn outwardly to a first work station where tab 28 is formed in web 34 by a punch 38. Punch 38 comprises a support 40 located beneath web 34 and a conventional punching apparatus which forms breakaway tabs or a three- quarter depth punch to result in a frangible section 42 which can be easily broken from web 34 into tab 28.

Web 34 is then advanced to the second work station where frangible section 42 is broken from web 34 and applied to the face of printhead 10 by a pressure apparatus 44. Pressure apparatus 44 applies a light pressure to frangible section 42 to break tab 28 from web 34 and temporarily tack tab 28 to printhead 10. Pressure apparatus 44 can be any conventional device which is designed to apply a light uniform pressure, such as a metal block with a rubber pad in the form of a plunger. Alternatively, pressure apparatus 44 can comprise a heat applicator which would apply a low level of heat to frangible section 42 to break section 42 from web 34 and tack tab 28 onto printhead 10.

As shown in Figure 4, once tab 28 is temporarily tacked onto printhead 10, printhead 10 is moved to a third work station where a short burst of heat is applied to tab 28 which is sufficient to reflow low melt material layer 32 of tab 28 onto the face of printhead 10. The third work station includes a heater 46 such as a heat gun. Heater 46 applies a short burst of heat, for about 3 seconds for example, at a temperature of below about 204°C (400°F) in ord r t protect adjacent plastic materials from heat damage. Heater 46 is an aluminum block with a caloride heater and temperature sensor which supplies the short burst of heat at about 177°C (350°F). Reflowing of material 32 causes the seal to accommodate any uneven surfaces on

the face of the printh ad and causes material 32 to flow partially into ink channels 24 which keeps nozzles 26 clean and free of ink until installation. Heater 46 could also be replaced by a radiant heat apparatus, an ultrasonic device, a high pressure plunger or any apparatus which would cause material layer 32 to reflow.

It is also possible to combine the second and third work stations such that frangible section 42 of web 34 is removed and sealed in place by a heater such as 46 thus eliminating the step of temporarily tacking tab 28 to printhead 10 by pressure apparatus 44.

The final work station shown in Figure 4 comprises a cooling station in which a blower 48 directs air onto tab 28 in order to solidify low melt material 32 and secure tab 28 in place. Blower 48 is optional since cooling can be accomplished by ambient air. Additionally, other types of conventional cooling apparatus such as a cold stamp or chiller could be used in place of blower 48.

Other methods of applying tab 28 to printhead 10 are also suitable. For example, tab 28 can be prepunched or cut and individually applied to the face of printhead 10. Tab 28 could also be applied using a bowl fed process or other types of conventional assembly line processes. Tabs 28 could even be applied by hand. The application of tabs 28 are especially applicable to thermal ink jet technology using side shooting where heater plate 20 is matched with channel plate 18 and diced, at which time tab 28 could be immediately applied to printhead die 12. Thus, it is seen that any method of applying tab 28 to face of printhead 10 is suitable. It is evident that placement of seal 28 does not require precise manufacturing processes and therefore can be inexpensively executed. Although the present invention has been described with respect to a thermal ink jet cartridge type printhead, the seal in accordance with the present invention can be applied to any type of printhead having nozzles in the face thereof, including a page width printhead or a staggered array printhead. Individual seals or one large seal could be used in such situations. The seal in accordance with the present invention could also be used in piezoelectric printing assemblies or any printing assembly in which it is desirable to seal the printing nozzles prior to installation.

While advantageous embodiments have been chosen to illustrate the invention, it would be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

Claims

1. A seal (28) for a printhead face, characterised in that the seal (28) comprises

   a laminat tab including a film (30) having a layer of low temperature melt material (32) disposed on one side thereof for molding to the face of the printhead (10).

2. A seal according to claim 1, wherein the tab is removably adherable to the face of the printhead (10).

3. A seal according to claim 1 or claim 2, wherein said film (30) has a higher melting point than said low temperature melt material (32).

4. A seal according to any one of claims 1 to 3, wherein said low temperature melt material (32) is material that reflows upon application of heat.

5. A seal according to any one of claims 1 to 4, wherein said low temperature melt material (32) is material that reflows upon heating at a temperature of about 204°C (400°F) or less.

6. A seal according to any one of claims 1 to 5, wherein said tab is reflowable.

7. A printhead assembly comprising:

   a printhead die (12) with a face having nozzles (26) therein; and

   a seal (28) removably secured to said face, characterised in that said seal (28) includes a laminate tab having a first layer (30) and a second layer (32) of low temperature melt material coupled to said first layer (30), said second layer (32) being reflowed onto said face and covering said nozzles (26).

8. A method of sealing the face of a printhead (10), characterised by

   thermally bonding a removable film laminate tab onto the face.

9. A method of sealing the face of a printhead (10) with a laminate tab having a low melt material on one side thereof, comprising:

   punching a breakaway tab into a web (34) of laminate film; and

   applying the low melt material side of the tab to the face of the printhead (10) including breaking the tab from the web and molding the tab onto the face.

10. A method as claimed in claim 8 or claim 9, wherein applying the tab onto the printhead (10), comprises temporarily tacking the tab to the face of the printhead.

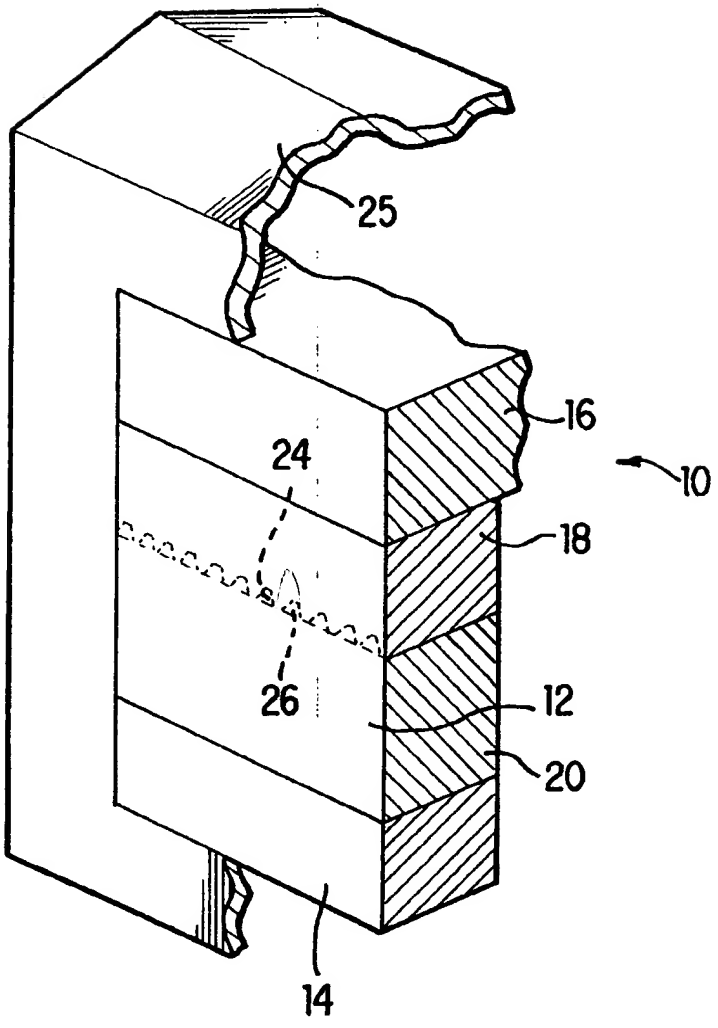

FIG. 1

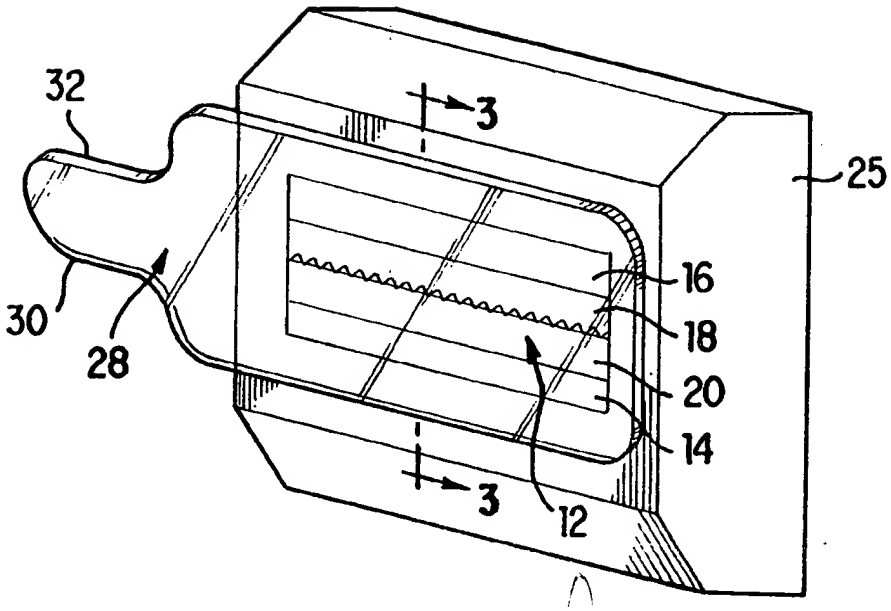

FIG. 2

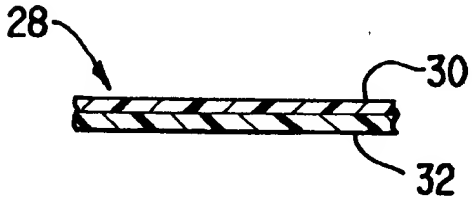

FIG. 3

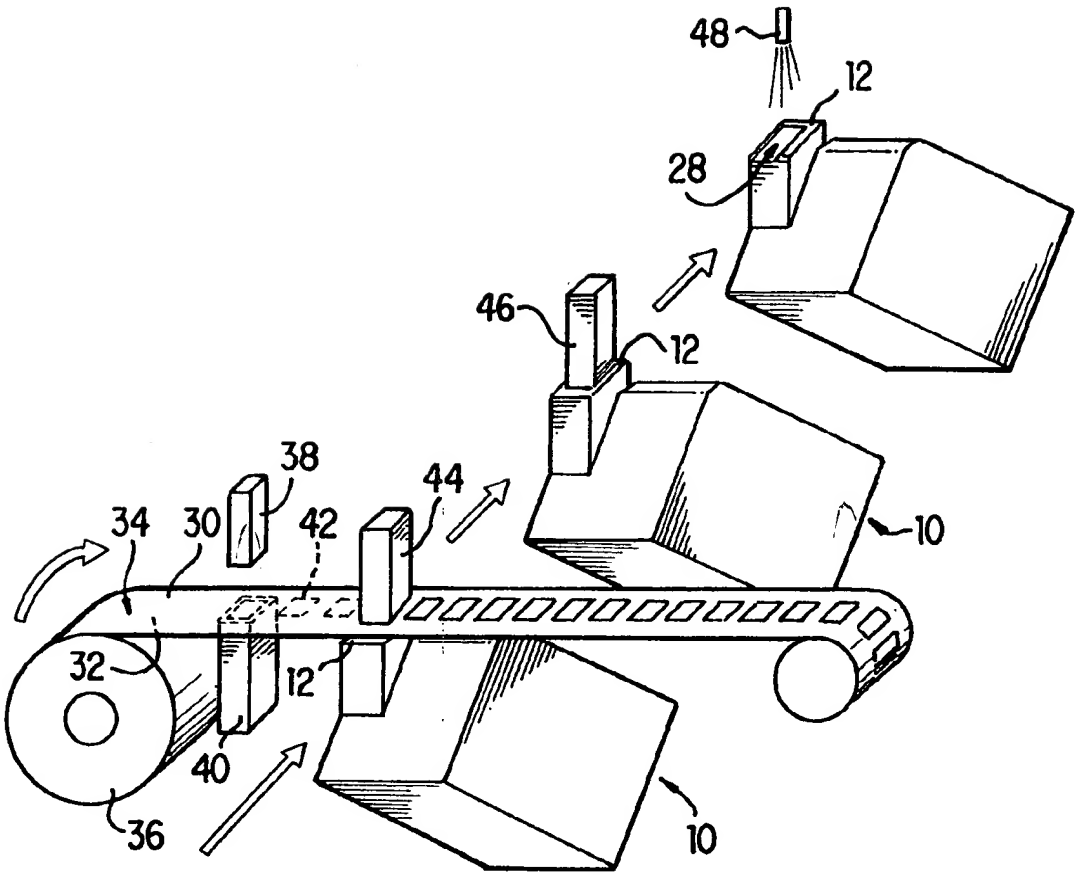

FIG. 4